

## THE GEOLOGY OF THE COUNTY OF SANDON, N.S.W.

By A. H. VOISEY, M.Sc., Lecturer in Geology and Geography, New England University College.

(Two Text-figures.)

[Read 23rd September, 1942.]

This paper deals with the general geology of the County of Sandon, and small parts of the adjoining counties of Clarke and Hardinge. The City of Armidale lies in the centre of the area mapped.

Expenses incurred during field operations were covered by a grant from the Commonwealth Research Fund.

### *Previous Literature.*

E. C. Andrews (1900, 1903, 1904, 1905, 1907) was responsible for most of the early field work carried out in the district. He mapped the Hillgrove area, and boundaries shown on the map (Fig. 1) in that neighbourhood were surveyed by him (Andrews, 1900).

H. G. Raggatt (1938) surveyed a large part of the country east of Wollomombi Creek and his work has been drawn upon for much of the information relating to this region.

A small area around the City of Armidale was mapped by the writer in 1938 (Voisey, 1938).

### STRATIGRAPHY.

#### *Summary.*

Lower Palaeozoic rocks comprise the Nambucca Series, the Woolomin Series and possibly rocks of Devonian age. Difficulty has been experienced in attempting to separate these beds. Approximate boundaries are shown on the map (Fig. 1). All these rocks have been intruded and metamorphosed by Upper Palaeozoic granites and porphyries. In addition, the Nambucca Series contains synchronous intrusions, possibly of Silurian age.

In depressions in the surface carved from the Palaeozoic rocks lie Tertiary gravels and plant beds which will be called the Armidale Series. These have been covered and metamorphosed by sheets of basalt.

Erosion has exposed the Tertiary sediments and underlying rocks.

### ORDOVICIAN?

#### *The Nambucca Series.*

Slates and phyllites occupy a large part of the country to the east of Armidale. For the most part they are similar in character to the rocks of the Nambucca Series which are exposed on The Big Hill, and in road cuttings between Wollomombi and Bellbrook on the Armidale-Kempsey road.

Andrews (1900, p. 14) described the Hillgrove beds as altered slates, schists and quartzites, siliceous schists and siliceous slates preserving a strike of north 20 degrees west, but varying from north 8 degrees east to north 23 degrees west. He also stated that the slates were black in colour with some white bands. To the slates tuffs may be added, and these may be collected from the dumps of the old Eleanor Mine.

The Hillgrove rocks, though perhaps hardly altered sufficiently to deserve the name of schists, are not typical of the Nambucca Series. They are included in it here only because they have been intruded by the gneissic granite and, therefore, are probably Silurian or pre-Silurian in age.

Characteristic Nambucca slates and phyllites are exposed in a number of places, of which the following may be cited:

1. In Rockvale Creek, near the village of Rockvale—vertical and striking east-west.
2. Road cuttings between Wollomombi and Hillgrove—vertical and striking east-west.
3. Around the Gara River Dam site.
4. At intervals along the connecting road from Rockvale to Wollomombi—strike north-east.
5. From a mile and a half east of the Armidale-Mihi road to Enmore and beyond—strike varying from north 30 degrees east to north 70 degrees east.

The western limit of the series seems to run in a direction north 10 degrees east from a point just east of Mihi Station to the neighbourhood of Aberfoyle. It is possible that this marks the position of a fault, since the younger rocks to the west strike constantly north and south.

The slates and phyllites of the Nambucca Series have been developed from fine-grained sediments by dynamic metamorphism. They cleave readily, in most cases in directions parallel or sub-parallel to the lamination. At the dam site on the Gara River the cleavage has been developed in two main directions, and the slate breaks into pieces up to three feet in length and only two or three inches in thickness. Associated with the slates are coarser beds which resemble quartzites.

The slates weather typically to a buff colour, but where they have suffered contact metamorphism as a result of their proximity to the intruding granite masses, they retain their dark colour and weather slowly. Numerous closely spaced quartz veins occur, and rocks containing them may be examined between Wollomombi and the Chandler River Bridge.

Two miles north of the Rockvale Creek crossing, slates give way to a series of tuffs and claystones. These may not belong to the same series as the slates, since they do not seem to have suffered the same degree of metamorphism. The slates reappear near the junction of the road from Rockvale and the Guyra-Ebor road.

Raggatt (1938, p. 118), after a study of aerial photographs, considered that the general structure was that of an anticline plunging to the north-west. He noted that the dips in the north were northerly at about 60 degrees, and those in the south were westerly.

#### DEVONIAN?

##### *The Woolomin Series.*

The same difficulty which Benson (1913, p. 495, 1915, p. 546, 1918, p. 328) encountered in his survey of the Great Serpentine Belt has arisen in the Armidale area. Although Benson abandoned the use of the name Woolomin in favour of Eastern Series, it retains its usefulness since it implies the presence of a distinctive lithology. Moreover, no spilites, limestones nor other rocks characteristic of any portion of the Tamworth or Barraba series have been encountered, although the olive-green mudstones, and green and grey tuffs somewhat resemble those in the series named.

The rocks consist of red jaspers, green and white quartzites, tuffaceous conglomerates, tuffs and mudstones. The jaspers in places are manganiferous. An attempt was made to separate the tuffs and mudstones, lying between Armidale and The Pinnacle, from the quartzites and jaspers, but these rocks were found interbedded with them. It has been decided, therefore, to include all the units in the Woolomin Series.

Good exposures of the jaspers and quartzites are to be seen in the hills lying immediately to the east of Armidale. In this neighbourhood their north-south strike is expressed by the topography. Tuffs and greenish-grey mudstones lie between these siliceous rocks, and a belt of quartzite which has been quarried near the Rugby League Football Ground, and which outcrops in Barney Street between Jessie and Markham Streets. Westward, tuffs outcrop at intervals along Dumaresq Creek, and again the jaspers and quartzites are met near New England University College.

As already described (Voisey, 1938, p. 463), tuffaceous sandstones, tuffs and mudstones are revealed by Saumarez Creek on the Armidale-Bundarra road. An outcrop near the head of Blackfellow's Gully consists mainly of manganiferous red jasper, but the tuffs are revealed by a tributary of the Gully near the road bridge.

Jaspers also lie in close proximity to an intrusion of lamprophyric rock which occurs in Blackfellow's Gully beside the road about half a mile west of the bridge.

Four miles south of Kelly's Plains on the Armidale-Gostwyck road tuffaceous conglomerates outcrop. They contain mostly hard rock types and the rounded pebbles are set in a coarse grey tuffaceous matrix. In some localities they show signs of having suffered some dynamic metamorphism. Other places where outcrops have been noted are:

1. Alongside the Armidale-Mihi road, a quarter of a mile north of Salisbury Creek.
2. East of Salisbury Lagoon, near Uralla.
3. On the road between Terrible Vale and Uralla, just east of Terrible Vale Creek.
4. At Dumaresq School.
5. Nine miles north of Armidale on the New England Highway.

The reason for the silicification of some of the sediments of this series to form quartzites and jaspers is unknown. It may be that it has some genetic connection with the great intrusions of granitic rock which took place at the close of Palaeozoic times.

#### TERTIARY.

The name of Armidale Series is given here to the Tertiary rocks occurring around the City. These consist principally of conglomerates, grits, sandstones and ferruginous cherty shales. A good section may be seen in the Gravel Pit on Portion 939, Parish of Armidale:

Ferruginous cherty shales, 6 inches thick.

Conglomerates, sandstones and grits, 8 feet thick.

These beds rest on quartzites of the Woolomin Series, and were overlain by basalt, the former position of which is indicated by silicification of some of the upper sediments.

The cherty shales are very fine grained, are laminated and exhibit conchoidal fracture. They contain numerous very well preserved plant remains, including the so-called *Cinnamomum*.

The conglomerates and grits pass laterally into each other. They are not so ferruginous in this locality as they are elsewhere in the district. They contain fragments of hard rock types, principally quartz, quartzites and jaspers. Those making up the conglomerates are well rounded and are set in a sandy matrix with iron oxides as cement.

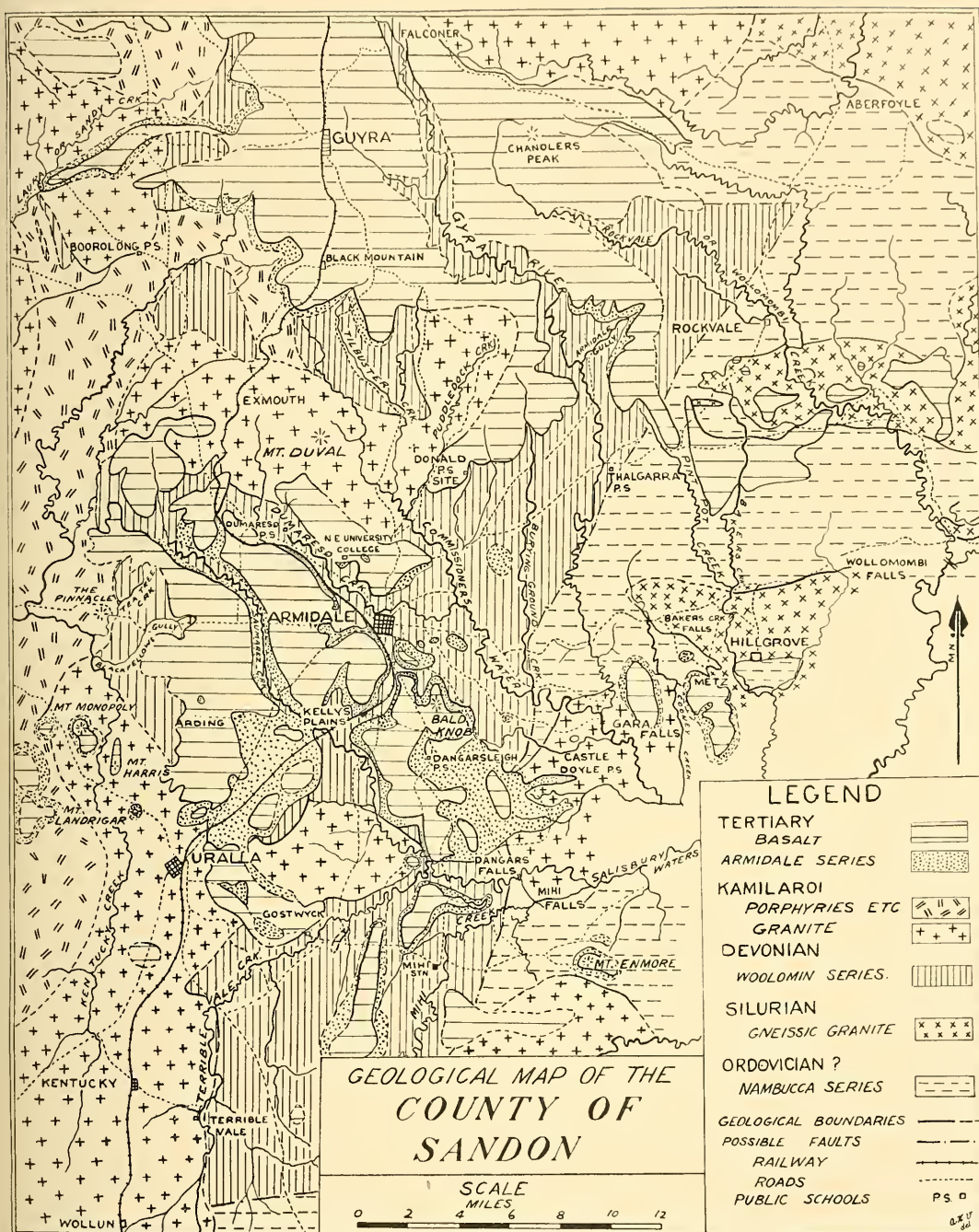
The accompanying map (Fig. 1) shows the widespread nature of the deposits, but erosion has removed all trace of their former presence over a much larger area.

Sediments similar to those in Portion 939 appear to be limited to the area between Wollomombi and Arding, and from North Armidale to Dangars Falls. They mark the former position of the Armidale lake in which they were laid down.

The lake deposits pass laterally into sediments which reflect the composition of the rocks on which they lie. Such material is evidently eluvial and may be termed fossil soil. At the junction of the New England Highway and the Big Range road, near Uralla, granite soil has been cemented into a siliceous rock which, in its outcrop, resembles an aplite. On examination it is seen to consist mainly of quartz grains. A similar rock occurs between Dangars Falls and Castle Doyle in the Parish of Tiverton. In each case the material overlies the parent granite.

On the road from Exmouth to Black Mountain, two miles from Black Mountain Railway Station, a fine-grained silicified rock contains numerous holes which indicate the former position of twigs in the altered soil. Silicification of the Tertiary sediments into the rock known as "grey-billy" has occurred in many places owing to the outpouring of basalt over them. The former position of the basalt above such material may be inferred.





## IGNEOUS ROCKS.

## LOWER PALAEOZOIC.

Raggatt (1938, p. 118) recorded the presence of a large mass of granite and a number of small sills in the Rockvale-Wollomombi area. He pointed out that the igneous rock was probably in the form of a synchronous batholith on account of the

fact that the schistosity and schlieren were arranged parallel to the strike of the intruded sediments.

One body of the granitic rock was traced from Wollomombi *via* Hillgrove to Cooney Creek and another was found to occur in the neighbourhood of Aberfoyle. The intrusions are elongated in an east-west direction.

With regard to the synchronous nature of the intrusions it is of interest to note that Andrews as early as 1900 (Andrews, 1900, p. 17) was impressed by the steep angle of slope of the granite and slate contact at Hillgrove. This feature, together with *lit-par-lit* injection of the gneissic rock into the slates of the Nambucca Series, may be seen near the Chandler River Bridge.

The intrusions have differentiated into a variety of rock types. Some of these were evidently the rocks mentioned by Andrews (1907, pp. 212-228). Analyses and descriptions were given and names allotted according to the C.I.P.W. classification. Among them are: No. 3,668 Camptonose, No. 3,584 Toscanose, No. 5,388 Kentallenose. He remarked upon the fact that the specimens of biotite granite of Hillgrove possess one common feature, namely, evidence of varying degrees of cataclastic action.

The generally lower percentage of silica, the presence of a great deal of biotite in most phases and the foliated character of the rocks distinguish them from the later intrusives which occur to the north and west of Hillgrove.

Near the Chandler River Bridge two phases of the intrusion occur. One is a dark rock, rich in biotite and relatively poor in quartz, and the other, which is poor in biotite and contains more quartz. The last-named is marginal, and it is suggested tentatively that it was formed during the time when pressure was being applied to the consolidating magma, as has been suggested to explain a similar occurrence at Cooma.

No petrological work has been carried out on the suite.

Raggatt's suggestion that the granite is epi-Silurian is accepted since post-Silurian beds do not appear to have shared the dynamic metamorphism which affected the Lower Palaeozoic rocks (Raggatt, 1938, p. 118).

#### UPPER PALAEOZOIC.

The New England bathylith containing a great variety of differentiates borders the area mapped. Apophyses and small bosses are present in the County of Sandon. The main intrusion has a meridional trend and traverses the whole New England Tableland.

Most of the descriptions given by Andrews (1907) refer to rocks of this intrusion. No detailed petrological work on the bathylith has been carried out by the writer, but it is being undertaken by Miss E. M. Basnett.

At Yarrowick, hornblende biotite granite outcrops, forming spectacular tors just east of the Uralla road junction. East of the Boorolong Creek crossing are aplites, porphyries and contaminated rock types. Through these run a series of quartz and orthoclase porphyries and porphyrites, some of which contain rock glass. The porphyry suite has an approximately meridional trend running from a point four miles west of Uralla to the Guyra-Inverell road near Wandsworth. Reconnaissance has shown them to continue for many miles north of this point.

Minor intrusions of lamprophyric and aplitic rocks have been examined between Saumarez Creek and The Pinnacle.

The age of the granitic mass is believed to be late Permian on account of the fact that it intrudes the Drake Series, and is overlain by Jurassic sediments. Much erosion must have occurred during Triassic times since the granite was exposed. A good section showing this relationship occurs at Kettle's Lift, near Tabulam (Voisey, 1939).

#### TERTIARY.

Outliers of basalt occur throughout the area. They are the remains of flows which covered almost the entire County of Sandon. Only high points like Mount Duval rose above the basaltic sheets.

Many hills are terraced, indicating that a number of flows were poured out. Two flows are in evidence between Armidale and Dangarsleigh. The topmost flow is fine grained and displays excellent prismatic jointing. In it are fragments of ultrabasic

rock, probably dunite, up to several inches across. This flow forms the top of Bald Knob and adjacent hills.

The basalt may be Oligocene or early Miocene in age, since it overlies sediments containing *Cinnamomum*.

#### CONCLUSION.

More work remains to be done before the detailed structure of the area will become apparent. The problem is tied up with that of the limits and nature of the so-called Woolomin Series, and its relation to the Nambucca and Tamworth Series. This is one of the most important and yet one of the most difficult tasks to be undertaken in New England.

The physiography of the area will be dealt with in a subsequent publication.

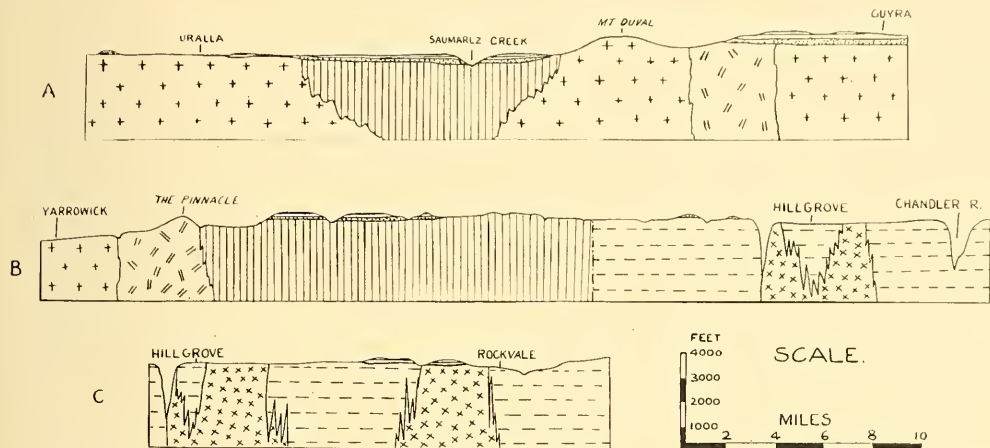


Fig. 2.—Geological sections across the map of the County of Sandon (Fig. 1).

A. Section from Uralla to Guyra.

B. Section from Yarrowick (just west of The Pinnacle) to Chandler River, near Wollomombi.

C. Section from Hillgrove to Rockvale.

The legend is the same as that shown on Fig. 1.

#### References.

- ANDREWS, E. C., 1900.—Report on the Hillgrove Gold Field. *Geol. Surv. N.S.W., Min. Res. No. 8*.  
 ———, 1903.—An Outline of the Tertiary History of New England. *Rec. Geol. Surv. N.S.W.*, 7, pt. 3.  
 ———, 1904.—The Geology of the New England Plateau, with Special Reference to the Granites of Northern New England. Part I. *Ibid.*, 7, pt. 4.  
 ———, 1905.—Id., Parts II and III. *Ibid.*, 8, pt. 2.  
 ———, and MINGAYE, J. C. H., 1907.—Id., Part IV. *Ibid.*, 8, pt. 3.  
 BENSON, W. N., 1913.—The Geology and Petrology of the Great Serpentine Belt of New South Wales. Part I. *Proc. Linn. Soc. N.S.W.*, 38, 490-517.  
 ———, 1915.—Id., Part V. *Ibid.*, 40, 540-624.  
 ———, 1918.—Id., Part VII. *Ibid.*, 43, 320-360, 363-384.  
 RAGGATT, H. G., 1938.—Geological Features of Chandler-Oaky-Styx-George Areas. *A.R. Dept. Mines N.S.W.*, for 1937, 117-121.  
 VOISEY, A. H., 1938.—The Geology of the Armidale District. *Proc. Linn. Soc. N.S.W.*, 63, 463-467.  
 ———, 1939.—The Geology of the County of Buller, N.S.W. *Ibid.*, 64, 385-393.